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## ON - LINE TEXT VALIDATION

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## ERROR REPORT

PATENT NO: 56055692.001

GROUP: T1

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## D A C S - E R R O R R E P O R T

PATENT #: 56055692.001      ISSUE DATE: 06/10/02      GROUP: T1  
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INFO, NO DACS VALIDATION ERRORS HAVE BEEN FOUND...  
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ENDED TEXT DACS VALIDATION FOR: \*\*\*\*\* 56055692.001 \*\*\*\*\*  
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\*-\*-\* NEW PATENT \*-\*-\*

Group T1

PATENT # 56055692.001

0001 +pg,1

0002 +sa

0003 An ethylene/+60 -olefin polymer blend is described comprising first <<<  
>>>and second ethylene/+60 -olefin

0004 polymer components in which the ethylene content of the first <<<  
>>>component is at least 10

0005 weight percent different than the ethylene content of the second <<<  
>>>component. These blends

0006 exhibit an improved combination of low temperature, pellet flow, <<<  
>>>compression set, melt strength

0007 and/or shape retention properties as compared to either component, or <<<  
>>>an ethylene/+60 -olefin

0008 polymer blend of similar composition but in which the ethylene <<<  
>>>content of each component is

0009 substantially the same.

0010 +ea

0011 +pg, 2

0012 <sup>10</sup>+p This application claims priority from Provisional application Ser. <<<<

>>>No. +b 60/203,298, +1

0013 filed May. +b 11, 2001.

0014 +su +cl FIELD OF THE INVENTION

0015 +p This invention relates to ethylene/+60 -olefin polymer blends. In <<<<  
>>>one aspect, this invention

0016 relates to polymer blends comprising two or more ethylene/+60 -olefin <<<<  
>>>components while in

0017 another aspect, this invention relates to blends in which one or more <<<<  
>>>of the components

0018 comprises an ethylene/+60 -olefin/polyene polymer. In yet another <<<<  
>>>aspect, this invention relates to

0019 polymer blends of ethylene/+60 -olefin components in which the <<<<  
>>>ethylene content of one

0020 component differs from the ethylene content of at least one other <<<<  
>>>component by at least about +b 10 +1

0021 weight percent.

0022 +cl BACKGROUND OF THE INVENTION

0023 +p Ethylene/+60 -olefin polymer blends are well known in the art. The <<<<  
>>>blends taught in U.S. Pat<sub>0</sub> Nos.

0024 +b 4,438,238; 4,722,971; 4,874,820; 4,902,738; 4,937,299; 4,939,217; <<<<  
>>>5,013,801; 5,236,998;

0025 5,292,845; 5,382,631; 5,494,965; 5,539,076; 5,691,413; 5,728,766; 4,<<<<  
>>>429,079; 4,530,914;

0026 5,605,969; 5,338,589; 5,260,384; 5,478,890; 5,438,100; 5,476,903; 5,<<<<  
>>>703,180; 5,464,905;

0027 5,744,551; 5,747,620 +1 and +b 5,798,427 +1 are representative, and <<<<  
>>>each of these patents are

0028 incorporated herein by reference.

0029 +p Blends are useful because they provide properties not available <<<  
>>>from the individual

0030 components from which the blend is made. For example, an ethylene/+60 <<<  
>>>-olefin polymer with a

0031 relatively narrow molecular weight distribution (MWD), e.g., +b 2 +1 <<<  
>>>or less, will usually produce a

0032 film with good transparency but it will usually process less <<<  
>>>efficiently than an ethylene/+60 -olefin

0033 +pg,3

0034 polymer alike in all aspects except with a MWD of +b 3 +1 or more. <<<

>>>However, an ethylene/+60 -olefin

0035 polymer with a MWD of +b 3 +1 or more usually produces a film that is <<<

>>>less transparent than a like

0036 ethylene/+60 -olefin polymer with a MWD of +b 2 +1 or less. Blending <<<

>>>the two polymers will usually

0037 produce a composition that will produce a film with both desirable <<<

>>>transparency and

0038 processability. Moreover, depending upon the particular ethylene/+60 -<<<

>>>olefin polymers, the relative

0039 proportions of each, the manner in which the polymers are made and/or <<<

>>>blended, the properties

0040 of interest and a host of other variables, one or more properties of <<<

>>>the blend may be more than a

0041 simple average of its component parts.

0042 +p While ethylene/+60 -olefin polymer blends can be prepared by any <<<

>>>one of a number of

0043 different processes, generally these processes fall into one of two <<<

>>>categories, i.e., post-reactor

0044 blending and in-reactor blending. Illustrative of the former are melt <<<

>>>extruders into which two or

0045 more solid ethylene/+60 -olefin polymers are fed and physically mixed <<<

>>>into a substantially

0046 homogeneous composition, and multiple solution, slurry or gas-phase <<<

>>>reactors arranged in a

0047 parallel array the output from each blended with one another to form <<<

>>>a substantially

0048 homogeneous composition which is ultimately recovered in solid form. <<<

>>>Illustrative of the latter

0049 are multiple reactors connected in series, and single reactors <<<  
>>>charged with two or more catalysts.

0050 While each general process category has its own advantages and <<<  
>>>disadvantages, in-reactor

0051 blending is a favored technique for making blends in which component <<<  
>>>compatibility, i.e., the

0052 ability to make a substantially homogeneous blend from the components,<<<  
>>> is a factor. Generally,

0053 forming a substantially homogeneous blend from ethylene/+60 -olefin <<<  
>>>polymer components that are

0054 less than fully compatible is easier and more successful and cost <<<  
>>>effective using an in-reactor

0055 technique than a post-reactor technique, particularly melt extrusion.

0056 +pg, 4

0057 +p Ethylene/+60 -olefin polymers and blends of these materials are <<<  
>>>commercially important

0058 because they exhibit and/or impart desirable properties to various <<<  
>>>products, e.g., films and

0059 molded and extruded articles. Properties of frequent interest are low <<<  
>>>temperature impact

0060 strength, compression set, melt strength, shape retention, pellet <<<  
>>>flow, mechanical strengths and

0061 modulus. Depending upon the end use, often one or more of these <<<  
>>>properties will be more

0062 important than the others. Enhancement of these more important <<<  
>>>properties often requires the

0063 use of a blend of ethylene/+60 -olefin polymers. The industry <<<  
>>>interest, of course, is in blends in

0064 which the properties of primary importance are enhanced without <<<  
>>>significant diminution of the

0065 other properties.

0066 +cl SUMMARY OF THE INVENTION

0067 +p According to this invention, ethylene/+60 -olefin polymer blends <<<  
>>>with improved low

0068 temperature, pellet flow, compression set, melt strength and/or shape <<<  
>>>retention properties are

0069 prepared by blending a first ethylene/+60 -olefin polymer component <<<  
>>>with a second ethylene/+60 -olefin

0070 polymer component, with the proviso that the ethylene content of the <<<  
>>>first and second

0071 ethylene/+60 -olefin polymer components differ from one another by at <<<  
>>>least about +b 10 +l weight

0072 percent. The blends can be made by either post-reactor or in-reactor <<<  
>>>blending, and the weight

0073 ratio of first component to second component can vary widely, <<<  
>>>typically from between +b 80:20 +1 to

0074 +b 20:80. +1 One hallmark of this invention is that the enhanced <<<  
>>>properties of the blend are achieved

0075 without significant diminution of other desirable properties of the <<<  
>>>blend components.

0076 +pg,5

0077 +dr +cl BRIEF DESCRIPTION OF THE DRAWINGS

0078 +p FIG. 1 is a graph reporting the residual crystallinity of <<<  
>>>exemplary elastomer blends of

0079 this invention as compared to a control elastomer.

0080 +p FIG. 2 is a graph reporting the modulus G+40 +0 of exemplary <<<  
>>>elastomer blends of this

0081 invention as compared to a control elastomer and two commercially <<<  
>>>available elastomers.

0082 +de +cl DETAILED DESCRIPTION OF THE INVENTION

0083 +p The ethylene/+60 -olefin blend components of this invention are <<<  
>>>polymers, i.e.,

0084 interpolymers, of ethylene with at least one C+hd 3+1 <sup>H4</sup><sub>C+hd</sub> 20 +1 +60 <<<  
>>>-olefin (preferably an aliphatic +60 -olefin)

0085 comonomer, and/or a polyene comonomer, e.g., a conjugated diene, a <<<  
>>>nonconjugated diene, a

0086 triene, etc. The term interpolymer includes copolymers, e.g. <<<  
>>>ethylene/propylene (EP), and

0087 terpolymers, e.g. EPDM, but it is not limited to polymers made with <<<  
>>>only ethylene and one or

0088 two monomers. Examples of the C+hd 3+1 <sup>H4</sup><sub>C+hd</sub> 20 +1 +60 -olefins <<<  
>>>include propene, +b 1+1 -butene, +b 4+1 -methyl-+b 1+1 -pentene,

0089 +b 1+1 -hexene, +b 1+1 -octene, +b 1+1 -decene, +b 1+1 -dodecene, +b <<<  
>>>1+1 -tetradecene, +b 1+1 -hexadecene, +b 1+1 -octadecene

0090 and +b 1+1 -eicosene. The +60 -olefin can also contain a cyclic <<<  
>>>structure such as cyclohexane or

0091 cyclopentane, resulting in an +60 -olefin such as +b 3+1 -cyclohexyl-<<<  
>>>+b 1+1 -propene (allyl-cyclohexane) and

0092 vinyl-cyclohexane. Although not +60 -olefins in the classical sense <<<

>>>of the term, for purposes of this

0093 invention certain cyclic olefins, such as norbornene and related <<<  
>>>olefins, are +60 -olefins and can be

0094 used in place of some or all of the +60 -olefins described above. <<<  
>>>Similarly, styrene and its related

0095 olefins (e.g., +60 -methylstyrene, etc.) are +60 -olefins for <<<  
>>>purposes of this invention.

0096 +pg, 6

0097 +p Polyenes are unsaturated aliphatic or alicyclic compounds <<<  
>>>containing more than four

0098 carbon atoms in a molecular chain and having at least two double <<<  
>>>and/or triple bonds, e.g.,

0099 conjugated and nonconjugated dienes and trienes. Examples of <<<  
>>>nonconjugated dienes include

0100 aliphatic dienes such as +b 1,4+1 -pentadiene, +b 1,4+1 -hexadiene, <<<  
>>>+b 1,5+1 -hexadiene, +b 2+1 -methyl-+b 1,5+1 -hexadiene,

0101 +b 1,6+1 -heptadiene, +b 6+1 -methyl-+b 1,5+1 -heptadiene, +b 1,6+1 -<<<  
>>>octadiene, +b 1,7+1 -octadiene, +b 7+1 -methyl-+b 1,6+1 -octadiene,

0102 +b 1,13+1 -tetradecadiene, +b 1,19+1 -eicosadiene, and the like; <<<  
>>>cyclic dienes such as +b 1,4+1 -cyclohexadiene,

0103 bicyclo+8 +b 2.2.1+1 +9 hept-+b 2,5+1 -diene, +b 5+1 -ethylidene-+b <<<  
>>>2+1 -norbornene, +b 5+1 -methylene-+b 2+1 -norbornene, +b 5+1 -vinyl-+b <<<  
>>>

0104 2+1 -norbornene,

0105 bicyclo+8 +b 2.2.2+1 +9 oct-+b 2,5+1 -diene, +b 4+1 -vinylcyclohex-+b <<<  
>>>1+1 -ene, bicyclo+8 +b 2.2.2+1 +9 oct-+b 2,6+1 -diene,

0106 +b 1,7,7+1 -trimethylbicyclo-+8 +b 2.2.1+1 +9 hept-+b 2,5+1 -diene, <<<  
>>>dicyclopentadiene, methyltetrahydroindene, +b 5+1 -allylbicyclo+8

0107 +b 2.2.1+1 +9 hept-+b 2+1 -ene, +b 1,5+1 -cyclooctadiene, and the <<<  
>>>like; aromatic dienes such as +b 1,4+1 -diallylbenzene,

0108 +b 4+1 -allyl-+b 1+1 H-indene; and trienes such as +b 2,3+1 -<<<  
>>>diisopropenylidiene-+b 5+1 -norbornene, +b 2+1 -ethylidene-+b

0109 3+1 -isopropylidene-+b 5+1 -norbornene, +b 2+1 -propenyl-+b 2,5+1 -<<<  
>>>norbornadiene, +b 1,3,7+1 -octatriene,

0110 +b 1,4,9+1 -decatriene, and the like; with +b 5+1 -ethylidene-+b 2+1 -<<<  
>>>norbornene, +b 5+1 -vinyl-+b 2+1 -norbornene and +b 7+1 -methyl-+b

0111 1,6+1 -octadiene preferred nonconjugated dienes.

0112 +p Examples of conjugated dienes include butadiene, isoprene, +b 2,<<<

>>>3+1 -dimethylbutadiene-+b 1,3,1,2+1 -dimethylbutadiene-+b 1,3,1,4+1 -<<<

>>>dimethylbutadiene-+b 1,3,1+1 -ethylbutadiene-+b 1,3,2+1 -<<<

>>>phenylbutadiene-+b 1,3, +1 hexadiene-+b 1,3,4+1 -methylpentadiene-+b 1,<<<

>>>3,1,3+1 -pentadiene (CH+hd 3+1 CH+50 CH+13 CH+50 CH+hd 2+1 ; commonly

0113 called piperylene), +b 3+1 -methyl-+b 1,3+1 -pentadiene, +b 2,4+1 -<<<

>>>dimethyl-+b 1,3+1 -pentadiene, +b 3+1 -ethyl-+b 1,3+1 -pentadiene,

0114 and the like; with +b 1,3+1 -pentadiene a preferred conjugated diene.

0115 +p Examples of trienes include +b 1,3,5+1 -hexatriene, +b 2+1 -methyl-<<<

>>>+b 1,3,5+1 -hexatriene, +b 1,3,6+1 -heptatriene,

0116 +b 1,3,6+1 -cycloheptatriene, +b 5+1 -methyl-+b 1,3,6+1 -heptatriene, <<<

>>>+b 5+1 -methyl-+b 1,4,6+1 -heptatriene,

0117 +b 1,3,5+1 -octatriene, +b 1,3,7+1 -octatriene, +b 1,5,7+1 -<<<

>>>octatriene, +b 1,4,6+1 -octatriene, +b 5+1 -methyl-+b 1,5,7+1 -<<<

>>>octatriene,

0118 +b 6+1 -methyl-+b

0119 1,5,7+1 -octatriene, +b 7+1 -methyl-+b 1,5,7+1 -octatriene, +b 1,4,<<<

>>>9+1 -decatriene and +b 1,5,9+1 -cyclodecatriene.

0120 +pg, 7

0121 +p Exemplary copolymers include ethylene/propylene, ethylene/butene, <<<  
>>>ethylene/+b 1+1 -octene,

0122 ethylene/+b 5+1 -ethylidene-+b 2+1 -norbornene, ethylene/+b 5+1 -<<<  
>>>vinyl-+b 2+1 -norbornene, ethylene/-+b 1,7+1 -octadiene,

0123 ethylene/+b 7+1 -methyl-+b 1,6+1 -octadiene and ethylene/+b 1,3,5+1 -<<<  
>>>hexatriene. Exemplary terpolymers include

0124 ethylene/propylene/+b 1+1 -octene, ethylene/butene/+b 1+1 -octene, <<<  
>>>ethylene/propylene/+b 5+1 -ethylidene-+b 2+1 -norbornene,

0125 ethylene/butene/+b 5+1 -ethylidene-+b 2+1 -norbornene, ethylene/butene<<<  
>>>e/styrene, ethylene/+b 1+1 -octene/+b

0126 5+1 -ethylidene-+b 2+1 -norbornene, ethylene/propylene/+b 1,3+1 -<<<  
>>>pentadiene, ethylene/propylene/+b 7+1 -methyl-+b

0127 1,6+1 -octadiene, ethylene/butene/+b 7+1 -methyl-+b 1,6+1 -octadiene, <<<  
>>>ethylene/+b 1+1 -octene/+b 1,3+1 -pentadiene

0128 and ethylene/propylene/+b 1,3,5+1 -hexatriene. Exemplary tetrapolymer<<<  
>>>s include

0129 ethylene/propylene/+b 1+1 -octene/diene (e.g. ENB), ethylene/butene/+<<<  
>>>b 1+1 -octene/diene and

0130 ethylene/propylene/mixed dienes, e.g. ethylene/propylene/+b 5+1 -<<<  
>>>ethylidene-+b 2+1 -norbornene/piperylene.

0131 In addition, the blend components can include minor amounts, e.g. +b <<<  
>>>0.05+1 -+b 0.5 +1 percent by weight,

0132 of long chain branch enhancers, such as +b 2,5+1 -norbornadiene (aka <<<  
>>>bicyclo+8 +b 2,2,1+1 +9 hepta-+b 2,5+1 -diene),

0133 as diallylbenzene, +b 1,7+1 -octadiene (H+hd 2+1 C+50 CH(CH+hd 2+1 <<<  
>>>)+hd 4+1 CH+50 CH+hd 2+1 ), and +b 1,9+1 -decadiene

0134 (H+hd 2+1 C+50 CH(CH+hd 2+1 )+hd 6+1 CH+50 CH+hd 2+1 ).

0135 +p Typically, the blend components of this invention comprise at <<<

>>>least about +b 20, +l preferably

0136 at least about +b 30 +l and more preferably at least about +b 40, +l <<<

>>>weight percent ethylene; at least about +b 1, +l

0137 preferably at least about +b 5 +l and more preferably at least about <<<

>>>+b 10, +l weight percent of at least one +60 -olefin;

0138 and, if a polyene-containing terpolymer, greater than +b 0, +l <<<

>>>preferably at least about +b 0.1 +l and

0139 more preferably at least about +b 0.5, +l weight percent of at least <<<

>>>one conjugated or nonconjugated

0140 polyene. As a general maximum, the blend components of this invention <<<

>>>comprise not more

0141 than about +b 95, +l preferably not more than about +b 85 +l and more <<<

>>>preferably not more than about +b 75, +l

0142 weight percent ethylene; not more than about +b 80, +l preferably not <<<

>>>more than about +b 70 +l and more

0143 +pg, 8

0144 preferably not more than about +b 60, +1 weight percent of at least <<<  
>>>one +60 -olefin; and, if a terpolymer,

0145 not more than about +b 20, +1 preferably not more than about +b 15 +1 <<<  
>>>and more preferably not more than

0146 about +b 12, +1 weight percent of at least one of a conjugated or <<<  
>>>nonconjugated diene. All weight

0147 percentages are based on weight of the blend.

0148 +p Important to this invention is that the difference in ethylene <<<  
>>>content between the first and

0149 second components of the blend is at least about +b 10 +1 weight <<<  
>>>percent, preferably at least about +b 15 +1

0150 and more preferably at least about +b 20, +1 weight percent. The <<<  
>>>maximum difference in ethylene

0151 content between the first and second components of the blend can vary <<<  
>>>widely although as a

0152 practical matter, the maximum difference does not exceed about +b 30, <<<  
>>>+1 preferably about +b 25, +1 weight

0153 percent.

0154 +p The ethylene/+60 -olefin polymer components of this invention can <<<  
>>>be produced using

0155 conventional ethylene/+60 -olefin polymerization technology. <<<  
>>>Preferably, the ethylene/+60 -olefin

0156 polymer components of this invention are made using a mono- or bis-<<<  
>>>cyclopentadienyl, indenyl,

0157 or fluorenyl transition metal (preferably Group +b 4+1 ) catalysts or <<<  
>>>constrained geometry catalysts

0158 (CGC) in combination with an activator, in a solution, slurry, or gas <<<  
>>>phase polymerization

0159 process. The catalyst is preferably mono-cyclopentadienyl, mono-<<<  
>>>indenyl or mono-fluorenyl

0160 CGCs. The solution process is preferred. U.S. Pat. No. +b 5,064,802; <<<  
>>>+l WO+b 93/19104 +l (U.S. Ser. No. +b 8,003, +l filed

0161 Jan. +b 21, 1993+l ), and WO+b 95/00526 +l disclose constrained <<<  
>>>geometry metal complexes and

0162 methods for their preparation. Variously substituted indenyl <<<  
>>>containing metal complexes are

0163 taught in WO+b 95/14024 +l and WO+b 98/49212. +l The relevant <<<  
>>>teachings of all of the foregoing patents

0164 or their corresponding U.S. patents or allowed applications are <<<  
>>>hereby incorporated by reference

0165 for purposes of U.S. patent practice.

0166 +pg, 9

0167 +p In general, polymerization may be accomplished at conditions well <<<  
>>>known in the art for

0168 Ziegler-Natta or Kaminsky-Sinn type polymerization reactions, that is, <<<  
>>> temperatures from +b 0+1 -+b

0169 250+1 +20 +0 C., preferably +b 30+1 -+b 200+1 +20 +0 C., and <<<  
>>> pressures from atmospheric to +b 10,000 +1 atmospheres (+b 1013 +1

0170 megapascals (MPa)). Suspension, solution, slurry, gas phase, solid <<<  
>>>state powder polymerization

0171 or other process conditions may be employed if desired. A support, <<<  
>>>especially silica, alumina, or

0172 a polymer (especially poly(tetrafluoroethylene) or a polyolefin) may <<<  
>>> be employed, and desirably

0173 is employed when the catalyst is used in a gas phase polymerization <<<  
>>> process. The support is

0174 preferably employed in an amount sufficient to provide a weight ratio <<<  
>>> of catalyst (based on

0175 metal):support within a range of from +b 1:100,000 +1 to +b 1:10, +1 <<<  
>>> more preferably from +b 1:50,000 +1 to +b 1:20, +1

0176 and most preferably from +b 1:10,000 +1 to +b 1:30. +1 In most <<<  
>>> polymerization reactions, the molar ratio of

0177 catalyst:polymerizable compounds employed is from +b 10+hu<sup>+31b</sup> 12+b :1 +1 <<<  
>>> to +b 10+hu<sup>+31p</sup> 1+b :1, +1 more preferably from +b 10+hu +31

0178 9+b :1 +1 to +b 10+hu<sup>+31p</sup> 5+b :1.

0179 +p Inert liquids serve as suitable solvents for polymerization. <<<  
>>> Examples include straight and

0180 branched-chain hydrocarbons such as isobutane, butane, pentane, <<<  
>>> hexane, heptane, octane, and

0181 mixtures thereof; cyclic and alicyclic hydrocarbons such as <<<

>>>cyclohexane, cycloheptane,

0182 methylcyclohexane, methylcycloheptane, and mixtures thereof; <<<

>>>perfluorinated hydrocarbons

0183 such as perfluorinated C+hd 4-10 +1 alkanes; and aromatic and alkyl-<<<

>>>substituted aromatic compounds

0184 such as benzene, toluene, xylene, and ethylbenzene. Suitable solvents <<<

>>>also include liquid olefins

0185 that may act as monomers or comonomers including butadiene, <<<

>>>cyclopentene, +b 1+1 -hexene, +b 1+1 -hexane,

0186 +b 4+1 -vinylcyclohexene, vinylcyclohexane, +b 3+1 -methyl-+b 1+1 -<<<

>>>pentene, +b 4+1 -methyl-+b 1+1 -pentene, +b 1,4+1 -hexadiene,

0187 +b 1+1 -octene, +b 1+1 -decene, styrene, divinylbenzene, allylbenzene,<<<

>>> and vinyltoluene

0188 (including all isomers alone or in admixture). Mixtures of the <<<

>>>foregoing are also suitable. If

0189 +pg,10

0190 desired, normally gaseous olefins can be converted to liquids by <<<  
>>>application of pressure and used

0191 herein.

0192 +p The ethylene/+60 -olefin polymer components of this invention can <<<  
>>>be blended by any in-reactor

0193 or post-reactor process. The in-reactor blending processes are <<<  
>>>preferred to the post-reactor

0194 blending processes, and the processes using multiple reactors <<<  
>>>connected in series are the

0195 preferred in-reactor blending processes. These reactors can be <<<  
>>>charged with the same catalyst

0196 but operated at different conditions, e.g., different reactant <<<  
>>>concentrations, temperatures,

0197 pressures, etc, or operated at the same conditions but charged with <<<  
>>>different catalysts.

0198 +p Examples of processes that can be use to form the blends of this <<<  
>>>invention include the use

0199 of an ethylene/+60 -olefin polymerization catalyst utilized in <<<  
>>>combination with at least one

0200 additional homogeneous or heterogeneous polymerization catalyst in <<<  
>>>the same reactor or in

0201 separate reactors that are connected in series or in parallel to <<<  
>>>prepare polymer blends having

0202 desirable properties. An example of such a process is disclosed in WO <<<  
>>>+b 94/00500 +1 at page +b 29 +1 line

0203 +b 4 +1 to page +b 33 +1 line +b 17. +1 The process uses a continuous<<<  
>>>ly stirred tank reactor (CSTR) connected in

0204 series or parallel to at least one other CSTR or tank reactor. WO +b <<<

>>>93/13143 +1 (at page +b 2 +1 lines +b 19+1 -+b)

0205 31+1 ) teaches polymerizing monomers in a first reactor using a first <<<  
>>>CGC having a first reactivity

0206 and polymerizing monomers in a second reactor using a second CGC <<<  
>>>having a second reactivity

0207 and combining the products from the two reactors. Page +b 3, +1 lines <<<  
>>>+b 25+1 -+b 32 +1 of WO +b 93/13143 +1

0208 provides teachings about the use of two CGCs having different <<<  
>>>reactivities in one reactor. WO

0209 +b 97/36942 +1 (page +b 4 +1 line +b 30 +1 through page +b 6 +1 line <<<  
>>>+b 7+1 ) teaches the use of a two-loop reactor system.

0210 The relevant teachings of such applications or their corresponding <<<  
>>>U.S. patents and allowed

0211 applications are incorporated herein by reference for purposes of <<<  
>>>U.S. patent practice.

0212 +pg,11

0213 +p The polydispersity (molecular weight distribution or Mw/Mn or MWD) <<<  
>>>of the polymer

0214 blend generally ranges from at least about +b 2, +1 preferably at <<<  
>>>least about +b 2.1, +1 and especially at least

0215 about +b 2.2 +1 to about +b 10, +1 preferably about +b 6, +1 and <<<  
>>>especially about +b 4.

0216 +p The polydispersity index is typically measured by gel permeation <<<  
>>>chromatography (GPC)

0217 on a Waters +b 150+1 +20 +0 C. high temperature chromatographic unit <<<  
>>>equipped with three linear mixed bed

0218 columns (Polymer Laboratories (+b 10 +1 micron particle size)) <<<  
>>>operating at a system temperature of

0219 +b 140+1 +20 +0 C. The solvent is +b 1,2,4+1 -trichlorobenzene from <<<  
>>>which about +b 0.5+1 % by weight solutions of the

0220 samples are prepared for injection. The flow rate is +b 1.0 +1 <<<  
>>>milliliter/minute, and the injection size is

0221 +b 100 +1 microliters.

0222 +p The molecular weight determination is deduced by using narrow <<<  
>>>molecular weight

0223 distribution polystyrene standards (from Polymer Laboratories) in <<<  
>>>conjunction with their elusion

0224 volumes. The equivalent polyethylene molecular weights are determined <<<  
>>>by using appropriate

0225 Mark-Houwink coefficients for polyethylene and polystyrene (as <<<  
>>>described by Williams and

0226 Ward in <sup>14</sup>Journal of Polymer Science,<sup>14</sup>Polymer Letters, Vol. +b 6, +1 <<<  
>>>(+b 621+1 ) +b 1968+1 ) to derive the equation:+ps

0227 +ti M+hd polyethylene+1 +32 (+i a+1 )(M+hd polystyrene+1 )+hu b+ps

0228 +ps In this equation, a+32 +b 0.4316 +l and b+32 +b 1.0. +l Weight <<<

>>>average molecular weight,  $M_w$ , is calculated in

0229 the usual manner according to the formula:+ps

0230  $+ti \frac{M_w + 32}{93} + \frac{1}{(w + hd \frac{i}{i+1}) (M + hd \frac{i}{i+1})} + ps$

0231 +ps where  $w + hd \frac{i}{i+1}$  and  $M + hd \frac{i}{i+1}$  are the weight fraction and <<<

>>>molecular weight respectively of the  $i^{th}$  fraction

0232 eluting from the GPC column. Generally, the  $M_w$  of the polymer blend <<<

>>>ranges from about

0233 +b 10,000, +l preferably about +b 20,000, +l more preferably about +b <<<

>>>40,000, +l and especially about +b 60,000, +l to

0234 +pg,12

0235 about +b 1,000,000, +l preferably about +b 800,000, +l more <<<

>>>preferably about +b 600,000, +l and especially about

0236 +b 500,000.

0237 +p The polymer blends of this invention cover a range of viscosities, <<<  
>>>depending upon the

0238 molecular weight of the blend and optional post-polymerization <<<

>>>rheological modification. In

0239 general, the blend viscosity is characterized by a Mooney viscosity <<<  
>>>which is measured according

0240 to ASTM D +b 1646+l -+b 89 +l using a shear rheometer at +b 125+l +20 <<<

>>>+0 C. The polymer blend Mooney viscosity

0241 generally ranges from a minimum of less than +b 0.01, +l preferably <<<  
>>>+b 0.1, +l more preferably about +b 1, +l and

0242 especially about +b 15 +l to a maximum of about +b 150, +l preferably <<<  
>>>about +b 125, +l more preferably about

0243 +b 100, +l and especially about +b 70.

0244 +p The rheological or shear thinning behavior of the ethylene <<<  
>>>interpolymer is determined by

0245 measuring the ratio of interpolymer viscosity at +b 0.1 +l rad/sec to <<<  
>>>viscosity at +b 100 +l rad/sec. This ratio

0246 is known as the Rheology Ratio (RR), V+b 0.1/+l V+b 100, +l or more <<<  
>>>simply, +b 0.1/100. +l The RR is an

0247 extension of I+hd 10+l /I+hd 2 +l and as such, in those instances in <<<  
>>>which the measurement of I+hd 2 +l and I+hd 10 +l are

0248 difficult, e.g., the I+hd 2 +l is less than +b 0.5, +l or the <<<  
>>>molecular weight of the interpolymer is relatively

0249 high, or the Mooney viscosity of the interpolymer is greater than <<<  
>>>about +b 35, +l the RR of the

0250 interpolymer can be measured using a parallel plate rheometer.

0251 +p The density of the polymer blends is measured according to ASTM D-<<<<  
>>>+b 792, +l and this

0252 density ranges from a minimum of about +b 0.850 +l grams/cubic <<<<  
>>>centimeter (g/cm+hu 3+l ), preferably about

0253 +b 0.853 +l g/cm+hu 3+l , and especially about +b 0.855 +l g/cm+hu <<<<  
>>>3+l , to a maximum of about +b 0.970 +l g/cm+hu 3+l , preferably

0254 about +b 0.940 +l g/cm+hu 3+l , and especially about +b 0.930 +l <<<<  
>>>g/cm+hu 3+l . For those polymer blends that are

0255 elastomers, i.e., with a crystallinity less than about +b 45+l %, the <<<<  
>>>maximum density is about +b 0.895, +l

0256 preferably about +b 0.885 +l and more preferably +b 0.875, +l g/cm+hu <<<<  
>>>3+l .

0257 +pg,13

0258 +p For polymer blends intended for use as elastomers, the crystallinity is preferably less than

0259 about +b 40, +1 more preferably less than about +b 30, +1 percent, preferably in combination with a melting

0260 point of less than about +b 115, +1 preferably less than about +b 105, +1 C, respectively. Elastomeric

0261 polymer blends with a crystallinity of zero to +b 25 +1 percent are even more preferred. The percent

0262 crystallinity is determined by dividing the heat of fusion as determined by differential scanning

0263 calorimetry (DSC) a of polymer blend sample by the total heat of fusion for that polymer blend

0264 sample. The total heat of fusion for high-density homopolymer polyethylene (+b 100+1 % crystalline)

0265 is +b 292 +1 joule/gram (J/g).

0266 +p One hallmark of this invention is that a desirable property of one component of the blend

0267 can be enhanced without a significant diminution of one or more desirable properties of another

0268 component. For example, certain blends of this invention exhibit an enhanced low temperature

0269 impact property relative to one component of the blend without any significant diminution of the

0270 glass transition temperature (Tg) of the other component of the blend. Other blends of this

0271 invention exhibit the same phenomena (i.e., no significant diminution of Tg) with respect to

0272 pellet flow (i.e., the ability of pellets made from the blend to move

>>>pass one another without

0273 sticking or blocking), compression set for a given crystallinity, <<<  
>>>melt strength and shape retention.

0274 +p Another hallmark of this invention is that these blends exhibit an <<<  
>>>improved combination

0275 of low temperature, pellet flow, compression set, melt strength <<<  
>>>and/or shape retention properties

0276 as compared to an ethylene/+60 -olefin polymer blend of similar <<<  
>>>composition but in which the

0277 ethylene content of each component is substantially the same.

0278 +p The following examples are provided as a further illustration of <<<  
>>>the invention. Unless

0279 stated to the contrary, all parts and percentages are by weight.

0280 +pg,14

0281 +cl Specific Embodiment

0282 +p Four elastomers were prepared using a dual loop reactor such as <<<  
>>>that described in WO

0283 +b 98/49212. +l Each elastomers was prepared under the same <<<  
>>>conditions with the same reactants and

0284 catalyst and to the same total ethylene content (+b 66 +l weight <<<  
>>>percent based upon the weight of the

0285 polymer component) as the other elastomers. The control elastomer was <<<  
>>>a blend of two

0286 essentially identical components, i.e., the component made in the <<<  
>>>first loop reactor was

0287 essentially the same in composition and properties as the component <<<  
>>>made in the second loop

0288 reactor. The remaining three elastomers, i.e., Elastomers +b 1, 2 +l <<<  
>>>and +b 3, +l are embodiments of this

0289 invention. Each is essentially the same as the other and the control <<<  
>>>except that the ethylene

0290 content of the component made in the first loop reactor is different <<<  
>>>than the ethylene content of

0291 the component made in the second loop reactor. The composition, <<<  
>>>Mooney viscosity, weight

0292 average molecular weight (Mw), molecular weight distribution (MWD), <<<  
>>>temperature of

0293 crystallinity (Tc, both onset and peak), and glass transition <<<  
>>>temperature (Tg) for each elastomer

0294 and two commercially available elastomers (Dutral+198 +0 +b 4038 +l <<<  
>>>manufactured and sold by Enichem,

0295 and Nordel+198 +0 IP +b 4770 +l manufactured and sold by Dupont Dow <<<

>>>Elastomers) are reported in the

0296 following table.

0297 +pg,15

0298 +t,0150

0299 +p As is evident from the data in the above table, Elastomers +b 1, 2 <<<  
>>>+1 and +b 3 +1 not only have a

0300 lower Tg than the control elastomer, but also a lower Tg than the two <<<  
>>>commercially available

0301 elastomers (both of similar composition). Lower Tg usually means <<<  
>>>better low temperature

0302 flexibility in such products as seals, belts and automotive hoses.

0303 +p The residual crystallinity at elevated temperatures of Elastomers <<<  
>>>+b 1, 2 +1 and +b 3 +1 are compared

0304 with the Control Elastomer in FIG. 1. As can be seen from this graph, <<<  
>>>as the ethylene split

0305 between the elastomer components increases, the so does the residual <<<  
>>>crystallinity. Usually, the

0306 larger the residual crystallinity at higher temperatures, the better <<<  
>>>the shape retention of the

0307 elastomer (neat or deployed in its intended end-use).

0308 +p FIG. 2 reports the modulus G+40 0 of the Control Elastomer, <<<  
>>>Elastomers +b 1, 2 +1 and +b 3, +1 Nordel

0309 IP +b 4770 +1 and Dutral +b 4038. +1 Modulus G+b 3+1 +40 , or storage <<<  
>>>modulus, is another measure of the shape

0310 +pg,16

0311 retention of the elastomer. Here too, Elastomers +b 1, 2 +l and +b 3 <<<  
>>>+l outperform the Control Elastomer

0312 even with a slightly higher overall ethylene content.

0313 +p Finally, Elastomers +b 1 +l and +b 2 +l were compared with the <<<  
>>>Control Elastomer for pellet flow.

0314 Elastomers +b 1 +l and +b 2 +l demonstrated superior temperature <<<  
>>>resiliency and lower blocking than the

0315 Control Elastomer.

0316 +p Although the invention has been described in considerable detail <<<  
>>>through the

0317 specification and examples, one skilled in the art can make many <<<  
>>>variations and modifications

0318 without departing from the spirit and scope of the invention as <<<  
>>>described in the following claims.

0319 +pg,17

0320 +cm What is claimed is:

0321 +cm 1. An ethylene/+60 -olefin polymer blend comprising first and <<<  
>>>second ethylene/+60 -olefin

0322 polymer components in which the ethylene content of the first <<<  
>>>component differs by at

0323 least about +b 10 +1 weight percent from the ethylene content of the <<<  
>>>second component.

0324 +cm 2. The blend of claim 1 in which the ethylene content of the <<<  
>>>first component differs

0325 by at least about +b 15 +1 weight percent from the ethylene content <<<  
>>>of the second component.

0326 +cm 3. The blend of claim 1 in which the +60 -olefin in each <<<  
>>>component contains from +b 3 +1 to

0327 about +b 8 +1 carbon atoms.

0328 +cm 4. The blend of claim 3 in which the +60 -olefin in each <<<  
>>>component is propylene.

0329 +cm 5. The blend of claim 4 in which the first and second ethylene/+6<<<  
>>>0 -olefin polymer

0330 components further comprise a polyene.

0331 +cm 6. The blend of claim 5 in which the polyene is +b 5+1 -<<<  
>>>ethyldene-+b 2+1 -norbornene.

0332 +cm 7. The blend of claim 3 in which the +60 -olefin in the first <<<  
>>>component is propylene

0333 and the +60 -olefin in the second component contains from +b 4 +1 to <<<  
>>>+b 8 +1 carbon atoms.

0334 +cm 8. The blend of claim 7 in which at least one of the first and <<<  
>>>second ethylene/+60 -olefin

0335 polymer components further comprises a polyene.

0336 +cm 9. An ethylene/(+60 -olefin polymer blend comprising first and <<<  
>>>second ethylene/+60 -olefin

0337 polymer components, the blend prepared by (i) contacting ethylene, an <<<  
>>>+60 -olefin, an

0338 activated constrained geometry catalyst and, optionally, a polyene, <<<  
>>>under polymerization

0339 conditions, in a first reactor to produce the first ethylene/+60 -<<<  
>>>olefin polymer component, (ii)

0340 transferring the first ethylene/+60 -olefin polymer component to a <<<  
>>>second reactor and in the

0341 presence of the first ethylene/+60 -olefin polymer component, (iii) <<<  
>>>contacting fresh ethylene, an +60 -olefin,

0342 +pg,18

0343 an activated constrained geometry catalyst and, optionally, a polyene,<<<  
>>> under

0344 polymerization conditions to produce the second ethylene/+60 -olefin <<<  
>>>polymer component, the

0345 polymerizations of the first and second reactors conduct in such a <<<  
>>>manner that the ethylene

0346 content of the first ethylene/+60 -olefin polymer component is at <<<  
>>>least +b 10 +1 weight percent different

0347 than the ethylene content of the second ethylene/+60 -olefin polymer <<<  
>>>component.

0348 +cm 10. The blend of claim 9 in which the polymerization conducted in <<<  
>>>each reactor is a

0349 solution phase polymerization.

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PGP --> IDC REUSE MOVE SUMMARY SHEET FOR: 05605569 - 06/10/02 0037 OF 0223

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